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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/668,277	09/24/2003	Kei Watanabe	04329.2858-01	3508
22852	7590	09/02/2004	EXAMINER	
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP 1300 I STREET, NW WASHINGTON, DC 20005			TRINH, MICHAEL MANH	
			ART UNIT	PAPER NUMBER
			2822	

DATE MAILED: 09/02/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/668,277

Applicant(s)

WATANABE ET AL.

Examiner

Michael Trinh

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 September 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 13-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 13-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☒ Certified copies of the priority documents have been received in Application No. 10/201,892.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>9-24-03</u> . | 6) <input type="checkbox"/> Other: _____ |

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DETAILED ACTION

*** This office action is in response to Applicant's Pre-Amendment filed on September 24, 2004. Claims 13-20 are pending. Claims 1-12 were canceled.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

- (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
- (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
- (c) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

2. Claims 13,16,17 are rejected under 35 U.S.C. 102(e) & (a) as being anticipated by Smith et al (6,255,233).

Smith et al teach a method for forming a semiconductor device comprising at least the steps of: embedding an under interconnection layer 145 in an interlayer insulating layer 125 such that a surface thereof is exposed to substantially the same plane as a surface of said interlayer insulating layer 125 (Fig 3; col 4, lines 9-40); forming a diffusion preventive layer 150 to prevent diffusion of a metal included in the under interconnection layer 145, on at least the under interconnection layer 145 (Fig 3; Abstract; col 4, lines 41- 67); forming a first nitrogen-doped silicon oxide layer 160 on the diffusion preventive layer 150; forming a fluorine-doped silicon oxide layer 170 on the nitrogen-doped silicon oxide layer 160 (Fig 3; col 4, lines 41-67); forming an interconnection groove and a via hole extending from a bottom of the interconnection groove above the under interconnection layer in said fluorine-doped silicon oxide layer; and forming a plug in the via hole with a metal layer (Fig 4; col 5, lines 1-20; cols 5-6), to be in electrically contact with the under interconnection layer 145, and an upper interconnection layer 165/155 in the interconnection groove with the metal layer, to be electrically contact with the plug (Fig 4; col 5, lines 1-20). Re claim 16, wherein another diffusion preventive layer 180 is formed on at least the upper interconnection layer 165/155 to

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prevent diffusion of a metal included in the upper interconnection layer 165/155 (Fig 4, col 5, lines 21-67; Abstract). Re claim 17, wherein the interlayer insulating layer 125 comprises a fluorine-doped silicon oxide layer (col 4, lines 27-31).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 14-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smith et al (6,255,233) taken with Noma et al (6,437,424).

Smith teaches a method for forming a semiconductor device as applied above to claims 13, 16, and 17.

Re claims 14-15, Smith already teaches forming a first nitrogen doped silicon oxide layer 160 having a refractive index on the diffusion preventing layer 150, but lacks mention the refractive index of 1.50 or more and 1.55 or less (claim 14), and lacks mentioning nitrogen concentration of 6 atomic or more and 10.5 atomic or less (claim 15).

However, Noma teaches forming a first nitrogen doped silicon oxide layer 20 of SiON, wherein a refractive index includes 1.52, 1.54, etc. (col 8, lines 15-46); col 7, lines 14-23), wherein nitrogen concentration of the SiON layer 20 is preferably in a range of 5 atomic % to 10 atomic % (col 8, lines 38-46; col 7, lines 20-23).

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Therefore, the subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to form the first nitrogen doped silicon oxide layer of SiON of Smith et al by selecting the portion of the prior art's range of refractive index of at least 1.52 with a nitrogen concentration preferably in a range of 5 atomic % to 10 atomic %, as taught by Noma, which is within the range of applicant's claims. This is because of the desirability to improve trap-up rate and endurance characteristic, and to extend cycle life, wherein it also has been held to be obvious to select a value in a known range by optimization for the best results. *In Re Aller* 104 USPQ 233,255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In Re Swanson* 56 USPQ 372 (CCPA 1942).

5. Claims 18-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Smith et al (6,255,233) taken with Kunikiyo (6,4229,105) and Jang (6,235,633).

Smith teaches a method for forming a semiconductor device, as applied above to claims 13,16, and 17, wherein the interconnection groove and the via hole are formed in the fluorine doped oxide layer 170, wherein excess portion of a metal layer filled up the groove and the via hole are removed by polishing so as to form a plug 155 in the via hole and a planar upper interconnection metal layer 165 in the groove (Fig 3; col 4, line 9 through col 5, line 20; col 7, lines 19-41).

Re claims 18-20, Smith thus lacks forming a second nitrogen doped silicon oxide layer on the fluorine doped silicon oxide layer so that the groove is penetrated the second nitrogen doped layer (claim 18), wherein the metal layer is sufficient thick to fill up an interior of the groove (claim 19), and wherein the second nitrogen doped silicon oxide layer is removed after removing the metal layer (re claim 20).

However, Kunikiyo teaches (at Figs 9-13,14; col 12, line 9 through col 13) forming a second nitrogen doped silicon oxide layer 14 on the fluorine doped silicon oxide layer (FSG) 13; forming an interconnection groove in the FSG layer 13, wherein the groove penetrates the second nitrogen doped silicon oxide layer 14 (Figs 9-11; col 12, lines 15-67, re claim 18); forming a metal layer 23 in the groove and a via hole, wherein the metal layer 23 is formed with a thickness sufficient to fill up an interior of the groove and via hole, followed by removing the metal layer 23 over the second nitrogen doped silicon layer 15 (Fig 13; col 13, lines 10-60; re

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claim 19). Jang also teaches (at Fig 5; col 4, line 55 through col 5) forming a second nitrogen doped silicon oxide layer of SiON 40 on the oxide layer 30; forming a groove in the oxide layer 30, wherein the groove penetrates the second nitrogen doped silicon oxide layer 40 (Fig 5, re further claim 18); forming a metal layer 50 in the groove, wherein the metal layer 50 is formed with a thickness sufficient to fill up an interior of the groove, followed by removing the metal layer 50 over the second nitrogen doped silicon layer 40 (Figs 5-6; col 5, line 53 through col 6, line 37; re further claim 19); and removing the second nitrogen doped silicon oxide layer 40 after removing the metal layer 50 over the second nitrogen doped silicon oxide layer 40 (Fig 7; col 6, lines 25-65, re claim 20).

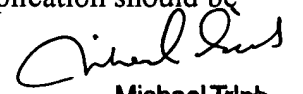
Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the semiconductor device of Smith et al by forming a second nitrogen doped silicon oxide layer on the fluorine doped silicon oxide layer, wherein the groove is penetrated the oxide layer and the second nitrogen doped layer, and wherein the metal layer is sufficient thick to fill up an interior of the groove, as taught by Kunikiyo and Jang, wherein removing the second nitrogen doped silicon oxide layer after removing the metal layer is taught by Jang. This is because of the desirability to use the second nitrogen doped silicon oxide layer as a stop layer during a chemical mechanical polishing process used to remove excess metal, wherein removing the second nitrogen doped silicon oxide stop layer after removing the metal layer by polishing with slurry would have been obvious to one of ordinary skill in the art because of the desirability to ensure and enhance the reliability and high quality of the semiconductor device. This is also because of the desirability to use the second nitrogen doped oxide layer of SiON as an antireflective layer that is useful for photolithography.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael M. Trinh whose telephone number is (571) 272-1847. The examiner can normally be reached on M-F: 8:30 Am to 5:00 Pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application should be directed to the receptionist whose telephone number is (703) 308-0956.

Oacs-3



Michael Trinh
Primary Examiner